FULL DEPTH PRECAST CONCRETE DECK PANEL SPECIAL PROVISION

Refer to Utah Department of Transportation (UDOT)
Full Depth Precast Concrete Panel Manual

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SPECIAL PROVISION

SECTION 03339S

FULL DEPTH PRECAST CONCRETE DECK PANELS

Delete section 03339 in its entirety and replace with the following

PART 1 GENERAL

1.1 SECTION INCLUDES

A. This work consists of furnishing, erecting, and grouting all precast concrete deck panels including all necessary materials and equipment to complete the work as shown on the plans.

B. Procedures for preparing and installing structural non-shrink grout.

C. Placing structural non-shrink grout into the camber strips, filling the shear stud blockouts and, if applicable, diaphragm blockouts and keyway blockouts in the bridge precast concrete deck panels.

D. Procedures relating to preparing bridge(s) for widening (including re-use of existing shear studs or other reinforcement used to make deck and slab composite) and grinding deck panels.

E. Procedures relating to installing new shear studs on top flanges of existing steel girders and installing T-Headed Bars to the top flanges of existing AASHTO or other prestressed concrete beams as shear studs.

F. Materials and procedures for applying a protective crack treatment and bridge deck overlay using epoxy-urethane polymers and a broadcast aggregate wearing surface.

1.2 RELATED SECTIONS

A. Section 02982: Bridge Concrete Grinding

B. Section 03055: Portland Cement Concrete

C. Section 03211: Reinforcing Steel and Welded Wire

D. Section 03252: Post Tensioning Concrete

E. Section 03310: Structural Concrete

F. Section 03372: Thin Bonded Polymer Overlay

G. Section 03412: Prestressed Concrete

1.3 REFERENCES

A. UDOT Quality Management Plan

B. AASHTO/AWS D1.5 2008 Bridge Welding Code

C. ANSI/AWS C6.1-89: American Welding Society's Recommended Practices for Friction Welding

D. AASHTO M169 Standard Specification for Steel Bars, Carbon, and Alloy, Cold-Finished

E. AASHTO M235: Standard Specification for Epoxy Resin Adhesives

F. AASHTO T106: Compressive Strength of Hydraulic Cement Mortar

G. AASHTO T160: Length Change of Hardened Hydraulic Cement Mortar and Concrete

H. AASHTO T161: Standard Method of Test for Resistance of Concrete to Rapid Freezing and Thawing

I. AASHTO T260: Standard Method of Test for Sampling and Testing Chloride Ion in Concrete and Concrete Raw Materials

J. ASTM A108: Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished

K. ASTM A109: Standard Specification for Steel Carbon Cold-rolled Strip

L. ASTM C494: Standard Specification for Chemical Admixtures for Concrete

M. ASTM A706: Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement

L. ASTM C666: Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing

M. ASTM C882: Standard Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear

N. ASTM C1042: Standard Test Method for Bond Strength of Latex Systems Used with Concrete by Slant Shear

O. ASTM E274: Standard Test Method for Skid Resistance of Paved Surfaces Using a Full-Scale Tire

P. ASTM E1512: Standard Test Methods for Testing Bond Performance of Bonded Anchors

Q. AASHTO M235: Standard Specification for Epoxy Resin Adhesives

R. PCI Design Handbook, Fifth Edition with all Interims and Errata

1.4 DEFINITIONS

A. Synthetic Fiber Reinforcement (SFR): a multi-filamentary fiber obtained by virgin polypropylene.

1.5 SUBMITTALS

A. Precast Concrete Deck Panels

1. Shop Drawings furnished to the Engineer for approval. Begin fabrication only after approval has been granted, Department rejects units fabricated before written approval;

:

a. Submit five (5) sets half-size, 11½ x 17 inch sheets with a 1½-inch blank margin on the left-hand edge.
b. Place the project designation data in the lower right-hand corner of each sheet.
c. Show all lifting inserts, hardware or devices and location on the shop drawings for Engineer's approval.
d. Prepare shop drawings under the seal of a Utah Professional Engineer.
e. Engineer reserves the right to retain these drawings up to 14 calendar days without granting an increase in the number of working days on the project. This is reduced to 7 days when the drawings are submitted electronically. This right applies each time the drawings are submitted.

2. Panel Handling:

a. All handling and erection bracing will conform to Chapter 5 of the PCI Design Handbook
b. The contractor's Professional Engineer will design and detail the panel lifting devices. Contractor will submit "no cracking" criteria calculations to shown that "Tensile stresses on both faces to be less than that which would cause cracking.

c. Submitted shop drawings will indicate locations of lifting devices, minimum clearances to edges of panels, additional reinforcement type, and amount.
d. Engineer reserves the right to retain these drawings up to 14 calendar days without granting an increase in the number of working days on the project. This is reduced to 7 days when the drawings are submitted electronically. This right applies each time the drawings are submitted.

3. Negative Moment Continuity Reinforcement (NMCR):
   a. Designer will design and detail the negative moment continuity reinforcement with the following as a minimum:
   b. NMCR is an additional #5 @ 24” minimum will be added to the typical panel top mat longitudinal reinforcement and post-stressing strands. Each end of the NMCR will have a standard 180-degree anchorage hook.
   c. Place the additional NMCR in any panel that is located over an interior bent and one panel each side of main panel. A minimum of two and maximum of three panels per interior bent will receive the additional NMCR.

B. Construction Methods
1. Provide construction methods to Engineer for approval..

2. Submit five (5) copies of shop drawings to the Engineer for approval. Drawings designed by a Professional Engineer include but are not limited to the following:
   a. Load distribution
   b. Cables and lifting equipment
   c. Type and location of lifting inserts or devices
   d. Details of vertical adjusting hardware

3. Do not order materials or begin work until receiving final approval of the shop detail drawings.

4. All details are subject to modification or approval.

5. Do not deviate from the approved shop drawings unless authorized in writing. Contractor is responsible for costs incurred due to faulty detailing or fabrication.

6. Engineer reserves the right to retain these drawings up to 14 calendar days without granting an increase in the number of working days on the project. This is reduced to 7 days when the drawings are submitted electronically. This right applies each time the drawings are submitted.

C. Erection Plan

1. Follow the sequence shown on the plans to remove the existing bridge deck slab (if applicable), erect new concrete beams or steel girders in the widening area (if applicable), and erect the new deck composed of precast concrete deck panels as shown on the panel layout and superstructure details sheets.

2. Submit a detailed plan to Engineer for approval 5 days before the panel erection begins. This detailed plan will include, but not be limited to the following information:

   a. Approximate location of cranes.
   b. Method of forming closure joints (if any).
   c. Panel erection plan and sequence.

D. Structural Non-Shrink Grout

1. Submit a Certificate of Compliance to Engineer.
2. Submit a proposed method for forming the camber strips and installing the structural non-shrink grout, sequence, and equipment for grouting operation to Engineer for review for a minimum of 14 days. Obtain approval prior to placing structural non-shrink grout begins.

E. Submit the name of the manufacturer of the Polymer Overlay materials, if applicable, at the Preconstruction Meeting.

F. Submit at the Preconstruction Meeting, a Certificate of Compliance for Polymer overlay Type 1; see Section 03372 Thin Bonded Polymer Overlay.

G. See Section 03252: Post Tensioning Concrete for additional submittal requirements

PART 2 PRODUCTS

2.1 MATERIALS

A. Mild Reinforced Panel: Use Class AA (AE) concrete for precast concrete deck panels as specified in Section 03055 and on the plans. Submit substitutions for self-consolidating concrete mix designs to Engineer for

approval as an alternate to the structural concrete for the precast deck panels.

B. Prestressed Panel: Use Class AA (AE) concrete according to Section 03055, except as modified by Section 03412 for Prestressed Concrete Panels. Use nominal aggregate of 3/4".

C. Use coated reinforcing steel as specified in Section 03211.

D. Show vertical adjusting hardware devices on the plans. Submit substitution for alternative devices to the Engineer for approval.

E. Use mechanical threaded couplers when specified for precast concrete deck panel reinforcing as specified in Section 03211. Do not use lap splices for mild reinforcement or post-tension bars within the panel. Lap splices are acceptable in cast-in-place closure pours.

F. Use structural non-shrink grout for camber strips, shear stud blockouts, diaphragm blockouts, keyway blockouts, and longitudinal joint.

1. Mix structural non-shrink grout just prior to use, in accordance with the manufacturer’s instructions.

2. Use non-shrink grout concrete gray in color and containing no calcium chloride or admixture containing calcium chloride or other ingredient in sufficient quantity to cause corrosion to steel reinforcement.

3. Follow manufacturer’s recommendation for dosage of corrosion inhibitor admixture.

4. Use quick-setting, rapid strength gain, non-shrink, and high-bond strength grout.

5. All grout will have synthetic fiber reinforcement mixed in to provide higher resistance to surface cracking.

6. Warranty the in-place structural non-shrink grout performance and workmanship for two (2) years.

7. Repair or refund at the Department’s option any bonding failures that occur during the warranty period.

8. Use structural non-shrink grout that meets a minimum compressive strength of 5,000 psi within 24 hours when tested as specified in AASHTO T 106.
9. Meet all the requirements of AASHTO T 160 with the exception that the Contractor-supplied cube molds will remain intact with a top firmly attached throughout the curing period.

10. Use structural non-shrink grout having no expansion after seven days and a one-hour compressive strength of 500 psi.

11. Refer to Table 1 for structural non-shrink grout requirements.

Table 1

Structural Non-Shrink Grout			
***Properties**	**Requirements**	**ASTM**	**AASHTO**
Accelerated Weathering	As Specified in ASTM or AASHTO	C666	T260
Accepted Bond Strengths	>1,000 psi @ 24 Hours	C882 or C1042	
Test Medium	<3% White Utah Road Salt		T161
Accepted Weight Loss	<15% @ 300 Cycles		T161
Friction Number	>40	E274	

*Certified test results from a private AASHTO accredited testing laboratory will suffice for acceptance.

G. Use a UDOT Certified Concrete Precaster or a pre-qualified project site caster for concrete products in accordance with the Department Quality Management Plan: Precast-Prestressed Concrete Structures.

H. Prior to stripping the forms, the precast panels will have a minimum flexural strength of 500 psi. Continuously wet cure the precast panels for 7-days commencing immediately after final finishing with all exposed surfaces covered. The precast panels will have a minimum cure of 14 days prior to placement.

I. Supply test data (slump, air voids, unit weight) for the fresh concrete, and flexural and compressive strengths for the hardened concrete after 7, 14, and 28 days (if applicable).

J. Post-Tensioning: Do not apply post tensioning before the concrete reaches a minimum compressive strength of 3000 psi. Establish minimum concrete strength by breaking concrete test cylinders cured at the job site under conditions similar to the curing of the post-tensioned elements.

Stressing will not commence until the concrete reaches the specified strength and age designated on the plans. Stress rods or strands within 72 hours of panel placement and transverse joint grouting to minimize early age concrete shrinkage cracking.

K. Provide documentation to the engineer that panel strength exceeds the specified design strength prior to allowing live traffic on the deck. Establish specified concrete strength by breaking concrete test cylinders cured at the job site under conditions similar to the curing of the post-tensioned elements. Engineer must approve test results prior to opening bridge to traffic.

L. Design and show all post-tensioning hardware and blockouts if required. Manufactured designed proprietary hardware is acceptable with approval of the Engineer.

2.2 THIN BONDED POLYMER OVERLAY, TYPE 1

A. See Section 03372 Thin Bonded Polymer Overlay for material requirements for Type 1 overlay.

2.3 SYNTHETIC FIBER REINFORCEMENT

A. Synthetic fiber reinforcement (SFR) is a multi-filamentary fiber obtained by virgin polypropylene. Include SFR in the cement matrix (concrete, grout, etc.) in order to constitute a homogeneous material able to inhibit plastic shrinkage cracking.

B. Homogeneously mix SFR through the grout or concrete, to control its plastic shrinkage and, consequently, increase compactness and oppose micro cracking.

C. The SFR will meet the following requirements:

Tensile strength	464,00-580,00 psi
Young's modulus	507,630-565,640 psi
Thickness	28 - 36 Microns
Cross Section:	Approximately Circular
Breakage elongation:	150-350%

D. Use strand length of approximately equal to half of the thinnest section of concrete, grout, or thin bonded polymer.

E. Add fibers directly to the concrete mixer after all other ingredients with a supplementary mixing time.

   a. Mix the SFR at a minimum of two pounds per cubic yard of concrete or grout.

F. Follow the recommendations of the manufacturer.

2.4 CONCRETE CORROSION INHIBITOR ADMIXTURE

A. The concrete corrosion inhibitor admixture will contain a minimum of 30% calcium nitrite by mass and formulated to meet ASTM C494 requirements for Type C, accelerating admixture.

B. Use a dosage rate of four (4) gallons per cubic yard unless otherwise directed by the manufacturer.

C. Use the admixture in all new concrete and grout placed.

2.5 PRESTRESSING STRAND, POST TENSIONING AND SHEAR CONNECTORS

A. See Section 03412: Prestressed Concrete for requirements.

B. See Section 03252: Post Tensioning Concrete for bar, strand, grout and other requirements.

C. New shear studs will be made from cold-drawn bars, Grades 1015, 1018 or 1020, either semi or fully killed, conforming to AASHTO M 169 Standard Specification for Steel Bars, Carbon, Cold-Finished, Standard Quality, and have a minimum tensile strength of 60.0 ksi.

   1. Use headed anchor studs for shear connectors conforming to dimensions showing on the plans. Use steel conforming to the requirement of AASHTO M-169. Automatically end weld studs in the shop or field with equipment designed for stud welding operations. Use equipment having capacity adequate for the size of stud welded.

D. If flux-retaining caps are used, the steel for the caps will be of a low carbon grade suitable for welding and will conform to ASTM A109 – Standard Specification for Steel, Carbon, Cold-Rolled Strip.

E. Friction welding conforms to the approved quality control manual and the American Welding Society’s Recommended Practices for Friction Welding

ANSI/AWS C.6.1-89.

F. On Concrete girders

1. T- Headed bars consist of deformed rebar with steel plates friction-welded to one end of the rebar.

2. The deformed rebar conforms to ASTM A706, Grade 60.

3. Cut plate heads from flats of hot-rolled steel conforming to ASTM A108.

4. Use an approved epoxy grout to develop minimum pullout strength in T-headed bar anchorage as shown on the Plan.

2.6 ADHESIVE DOWELLED ANCHORS

A. Epoxy resin adhesive for anchors will conform to AASHTO M235 Standard Specification for Epoxy Resin Adhesives.

B. Adhesive dowelled anchors:

1. Adhesive anchors will be installed and tested in accordance with the epoxy anchor test schedule and as follows:
   a. Test through the blockout is at the contractor’s risk. Repair the damaged panel per the Engineer's instructions or the panel will be rejected Repair the damaged beams or girders per the Engineer's instructions
   b. Test 25% of the first 40 anchors installed and 10% of all anchors Installed thereafter.
   c. If any failures occur, test the previous ten (10) anchors installed as well as the next five (5) anchors installed.
   d. Allow anchors to cure 48 hrs prior to testing.

2. Tension test will be in accordance with ASTM E1512.

3. Provide minimum capacity as defined in table below.

Epoxy anchor test schedule Schedule for anchors installed in hard rock concrete (2000 psi min. Strength)					
Reinforcing bars (f_y = 60 ksi)			Bolts or threaded rods (f_y = 36 ksi)		
Bar size	Minimum embedment	Tension test load (0.9fy)	Anchor diameter	Minimum embedment	Tension test load*
#4	6”	10800#	3/8”	5”	3384#
#5	7”	16700#	1/2"	7”	5400#
#6	9”	23800#	5/8"	8”	9390#
#7	10”	32400#	3/4"	10”	13530#
#8	12”	42700#	7/8”	12”	18417#
#9	13”	54000#	1"	13”	24050#
#10	16”	68600#	1 1/4”	15”	37580#
#11	18”	84200#			

Notes: * allowable loads equal 1/2 test load values

2.7 QUALITY ASSURANCE

A. Department pre-qualifies pre-cast and site-cast manufacturers according to the UDOT Quality Management Plan: Pre-cast/Prestressed Concrete Structures.

B. Permanently mark each precast unit with date of casting and supplier identification. Stamp markings in fresh concrete.

C. Prevent cracking or damage during handling and storage of precast units.

D. Replace cracked or damaged precast units at no additional cost to the Department.

E. Defects and Breakage Prestressed and Nonstressed Members .

1. Members that sustain damage or surface defects during fabrication, handling, storage, hauling, or erection are subject to review and rejection. Submit proposed written repair procedures and obtain approval before performing repairs. Repair work must reestablish

the member's structural integrity, durability, and aesthetics to the satisfaction of the Engineer. When damage occurs, determine the cause and take corrective action. Failure to take corrective action, leading to similar repetitive damage, could be cause for rejection of the damaged members. Cracks that extend to the nearest reinforcement plane and fine surface cracks that do not extend to the nearest reinforcement plane but are numerous or extensive are subject to review and rejection. Full depth cracking and breakage greater than 1 foot are cause for rejection.

2. Prestressed Members. Failure of individual wires in a 7-wire strand is acceptable if the total area of wire failure is not more than 2% of the total cross-sectional area of all strands in the member, and if no more than one wire fails in any single strand. Examine any setup with one or more broken wires by a licensed Professional Engineer or Quality Control Supervisor to determine the cause before continuing stressing operations on the particular casting line. Vertical or horizontal cracks 1/16 in. or less in width that tend to close upon transfer of stress to the concrete are acceptable. Cracks that do not tend to close are subject to review and may lead to panel rejection. Prestressed bridge deck panels will be rejected for any of the following conditions:
   a. Any crack extending to the reinforcing plane and running parallel and within 1 in. of a strand for at least 1/3 of the embedded strand length; or
   b. Any transverse or diagonal crack, including corner cracks and breaks, intersecting at least two adjacent strands and extending to the reinforcing plane. Prestressed bridge deck panels that sustain damage or surface defects during fabrication, handling, storage, hauling, or erection are subject to review and rejection.

F. Construct panels to tolerances set forth in the PCI Design Handbook Chapter 8.

PART 3 EXECUTION

3.1. FABRICATION

A. Do not place concrete in the forms until the Engineer has inspected and approved the placement of all materials in the deck panels.

B. Finish the precast concrete deck panels following Section 03310.

C. Perform prestressing in accordance to Section 03412 Prestressed Concrete.

3.2. NEW SHEAR STUDS ON EXISTING STEEL GIRDERS AND CONCRETE BEAMS

A. Installation of the Shear Studs and bars

1. Install shear studs or bars at the locations shown on the plans.

2. Weld shear studs to steel girders in accordance with applicable AWS specifications. Adjust studs as necessary to provide clearance for bolts in existing bolted splices. Use method and equipment recommended by the manufacturer of the studs and approved by the Engineer. Studs will be field welded.

3. Field drill holes in existing AASHTO prestressed concrete beam's top flange and install shear studs in accordance with manufacturer's recommendations. Use method and equipment recommended by the manufacturer of the studs, epoxy grout, and approved by the Engineer.

3.3. PLACING PRECAST CONCRETE DECK PANELS

A. Fully brace concrete beams or steel girders prior to placing of panels.

B. Place the precast concrete deck panels as shown on the plans or approved shop drawings.

C. Adjust leveling devices to approximate final condition prior to placing panel to ensure even distribution of forces.

D. Check the grade of the deck panels after all deck panels in a span are placed. Adjust to provide the elevations shown on the plans.

E. Prevent shifting of the precast concrete deck panels during the joining of all the deck panels.

3.4. LONGITUDINALLY POST TENSIONING

A. Clean and remove all debris from blockouts.

B. Set final elevations after all panels are in place

C. Grout shear keyway between post-tension blockouts.

D. Install rods per paired panel and tension to 40% of final jacking force prior to adding adjacent panel.

E. After placement of all panels, fully tension and grout all ducts in accordance to Section 03252 Post Tensioning Concrete.

F. Visually inspect the installation of all shear studs and connection details. Place structural non-shrink grout in the girder camber strips and shear stud blockouts in a continuous operation within a section a minimum of 56 days from panel fabrication. Complete without voids.

3.5 Installation of Headed T bars and anchors

A. Adhesive dowelled anchors:

1. Use reinforcing, bar dowels, reinforcing bars, threaded rods, bolts etc. as shown in the plans, which is to be adhesive dowelled into concrete.

2. Drill, brush, clean all holes, and install all anchors in complete accordance with manufacturers published recommendations, as well as all applicable building codes or Engineering reports.

3. Continuous inspection is required for installation of reinforcement or threaded rods.

4. Adhesive anchors will be installed and tested in accordance with the epoxy anchor test schedule and as follows:
   a. Test through the blockout is at the contractor’s risk. Repair the damaged panel per the Engineer's instructions or the panel will be rejected Repair the damaged beams or girders per the Engineer's instructions
   b. Test 25% of the first 40 anchors installed and 10% of all anchors Installed thereafter.
   c. If any failures occur, test the previous ten (10) anchors installed as well as the next five (5) anchors installed.
   d. Allow anchors to cure 48 hrs prior to testing.
   e. Tension test will be in accordance with ASTM E1512.

3.6 PREPARATION AND INSTALLATION OF STRUCTURAL NON-SHRINK GROUT

A. Clean and remove all debris from the camber strips and blockouts prior to placement of the structural non-shrink grout.

B. Keep bonding surfaces free from laitance, dirt, dust, paint, grease, oil, rust, or any contaminant other than water.

C. Pre-test the materials under field conditions at the grout pocket and/or camber strip anticipated to determine whether subsequent cracking will occur.

1. The corrective action will be at the discretion of the Engineer.

2. Proceed with grouting process at the direction of the Engineer.

D. Saturate surface dry (SSD) all surfaces receiving structural non-shrink grout.

E. Apply product following manufacturer's recommendations preparation and installation.

F. Cure structural non-shrink grout per manufacturer's recommendation.

1. Contact the manufacturer's representative for advice on how to reduce heat such as wet curing or adding retarding admixture if the heat of hydration is excessive.

G. Use a mix design in accordance with the requirements of Section 03055 if adding more than 15 lb of coarse aggregate (size No. 8) or larger per 50 lb bag of structural non-shrink grout.

H. Mix structural non-shrink grout just prior to use, in accordance with the manufacturer's instructions.

I. Repair or refund at the Department's option any bonding failures that occur during the warranty period.

J. Finish grout to a minimum of +1/8 inch high of existing profile.

1. Correct patch profiles in excess of 1/8 inch higher than the existing pavement profile through surface grinding.

a. Correct patch profiles in excess of 1/8 inch lower than the existing pavement profile through removal and replacement of the patch.
b. Pay for any corrections to the finish of the patch.

3.7 NON POST TENSIONED JOINTED PANELS

A. Connect panels using either the weld tie or shear keyway once panels have been placed and shear studs installed. Set final elevations after all panels are in place. Place structural non-shrink grout in the girder camber strips and blockouts in a continuous operation within a panel. Grouting will include all shear stud blockouts, diaphragm blockouts and keyways and camber strips.

B. Form and install, per the project documents, the camber strips as shown on the plans after the installation of the shear studs. Grout the shear stud blockouts, diaphragm blockouts and keyway blockouts (if applicable) and camber strips using structural non-shrink grout.

C. Leave no voids in the grout for the camber strips, shear stud blockouts, diaphragm blockouts, and/or keyway blockouts.

D. Cure non-shrink grout of camber strips and blockouts for at least two hours or obtained design strength prior to allowing additional superimposed dead loads or live loads to the precast concrete deck.

3.8 DECK GRINDING

A. Profile grind the deck and approaches after all panels are in place, grouting is complete and design strength is achieved see Section 02982: Bridge Concrete Grinding.

B. Grind no more than 1/4".

3.9 SURFACE PREPARATION

A. Prepare deck and approach slabs then place Polymer Overlay, Type 1. See section 03372: Thin Bonded Polymer Overlay.

3.10 PANEL HANDLING AND STORAGE

A. Handle and Store panels per the recommendation of the PCI Handbook.

3.11 WELDING

A. Perform all welding in accordance with AASHTO/AWS D1.5 Bridge Welding Code.

B. Perform friction welding in accordance to ANSI/AWS C6.1-89 Recommended Practices for Friction Welding.

END OF SECTION